

IN THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

1 (Currently Amended): A position detecting method for detecting positional information in a predetermined measurement direction of a mark formed on ~~a substance~~ an object, comprising:

picking-up at least one image of said mark under an image pick-up condition including a plurality of defocus states;

~~obtaining~~ estimating a relationship between ~~picked-up image state~~ a position of the picked-up image of said mark in said predetermined measurement direction and said defocus amount $[[,]]$ based on image pick-up results in said image pick-up condition $[[;]]$, and ~~detecting~~ estimating said positional information in said predetermined measurement direction of said mark based on said the estimated relationship.

2 (Original): The position detecting method according to claim 1, wherein in said picking-up the image, said image of said mark is picked-up on an image pick-up plane which tilts against an imaging plane on which said image of said mark is formed.

3 (Currently Amended): The position detecting method according to claim 1, wherein in said ~~obtaining said relationship~~ a estimating said positional information of said mark, positional information of said a characterized point at of said mark in a focus state is estimated ~~by using from~~ from said image ~~picked-up~~ pick-up results at in said plurality of said defocus states.

4 (Currently Amended): The position detecting method according to claim 3, wherein in said ~~obtaining said relationship a~~ estimating said positional information of said mark, estimating positional information of said characterized point ~~at a~~ in said focus state is ~~estimated, considering a respective~~ performed in consideration of contrast of each image pick-up results ~~at~~ result in said plurality of said defocus states.

5 (Currently Amended): The position detecting method according to claim 3, wherein said plurality of defocus states include ~~either plus defocus states or minus defocus state~~ one of a state of defocusing in one direction from said focus state and a state of defocusing in the other direction from the focus state, and

a position of said characterized point ~~at~~ in said focus state is estimated by an extrapolation method using positions of said characterized point obtained from said image pick-up results ~~at~~ in said defocus states.

6 (Currently Amended): The position detecting method according to claim 3, wherein ~~[[a]]~~ said plurality of ~~said~~ defocus states include ~~a plus defocus state and a minus defocus state~~ a state of defocusing in one direction from said focus state and a state of defocusing in the other direction from the focus sate, and

a position of said characterized point ~~at~~ in said focus state is estimated by an interpolation method using positions of said characterized point obtained from said image pick-up results ~~at~~ in said defocus states.

7 (Currently Amended): The position detecting method according to claim 1, wherein

said image pick-up condition further comprises a focus state, and ~~said obtaining relationship comprises: estimating~~

in said estimating said positional information of said mark, [[a]] positional information of said a characterized point at in said focus state using said picked-up image at is estimated based on image pick-up result in said focus state and image pick-up results in said plurality of defocus states; and further

~~estimating said positional information of said characterized point at said focus state using said picked-up image at said focus state.~~

8 (Currently Amended): The position detecting method according to claim 7, wherein in said ~~detecting~~ estimating said positional information of said mark, said positional information is estimated in consideration of, ~~considering a respective~~ contrast of each image pick-up ~~results at~~ result in said plurality of defocus states and image pick up result in said focus state.

9 (Currently Amended): The position detecting method according to claim 7, wherein said plurality of defocus states include ~~either plus defocus states or minus defocus states~~ one of a state of defocusing in one direction from said focus state and a state of defocusing in the other direction from the focus sate, and

a position of said characterized point at in said focus state is estimated by an extrapolation method using positions of said characterized point obtained from results at in said defocus states.

10 (Currently Amended): The position detecting method according to claim 7,
wherein

said plurality of defocus states include ~~a plus defocus state and a minus defocus state~~
a state of defocusing in one direction from said focus state and a state of defocusing in the
other direction from the focus state, and

a position of said characterized point mark at in said focus state is estimated by an
interpolation method using positions of said characterized point obtained from said image
pick-up results at in said defocus states.

11 (Currently Amended): The position detecting apparatus which detects a positional
information in a predetermined measurement direction of a mark formed on ~~a substance~~ an
object, comprising

an imaging optical system~~[[,]]~~ which forms an image of ~~the~~ said mark;

an image pick-up unit which picks-up the image of ~~the~~ said mark formed by ~~the~~ said
imaging optical system; and

a processing unit~~[[,]]~~ ~~which is~~ electrically connected to said image pick-up unit, ~~and~~
~~which obtains said estimates~~ a relationship between ~~picked-up image state of the~~ a position of
the picked-up image of said mark in said predetermined measurement direction and defocus
amount based on the image pick-up results by using said ~~the~~ image pick-up unit under an
image pick-up condition including a plurality of defocus states, and estimates positional
information in said predetermined measurement direction of said mark based on the estimated
relationship.

12 (Original): The position detecting apparatus according to claim 11, wherein

a surface condition of said mark is changing along a predetermined direction, and
said image pick-up unit comprises a image pick-up plane which is rotated around a
direction in an imaging plane on which said image is formed by said imaging optical system
corresponding to said predetermined direction.

13 (Original): The position detecting apparatus according to claim 12, wherein
said image pick-up plane intersects said imaging plane.

14 (Original): The position detecting apparatus according to claim 11, further
comprising:

a tilt adjustment mechanism which adjusts rotation amount of an image pick-up plane
of said image pick-up unit around a direction in an imaging plane on which said image is
formed by said imaging optical system corresponding to said predetermined direction.

15 (Original): The position detecting apparatus according to claim 11, further
comprising:

a moving mechanism which relatively moves a imaging plane, on which said image of
said mark is formed by said imaging optical system, and said image pick-up plane of said
image pick-up unit along an optical axis direction of the imaging optical system.

16 (Original): An exposure method for transferring a predetermined pattern to a
divided area on a substrate, comprising:

detecting a positional information of marks formed on the substrate for a position
detection by using said method according to claim 1, obtaining a predetermined number of

parameter for a position calculation of said divided area, and calculating an arrangement information of the divided area on the substrate; and

transferring the pattern to the divided area while controlling a position of said substrate, based on the arrangement information of said divided area.

17 (Original): An exposure apparatus which transfers a predetermined pattern to a divided area on a substrate, comprising:

a stage unit which moves said substrate along a moving plane; and

a position detecting apparatus according to claim 11, which detects positional information of said marks on the substrate mounted on the stage unit.

18 (Currently Amended): A making method of an exposure apparatus for transferring a predetermined pattern to a divided area on a substrate, comprising:

providing a stage unit which moves ~~the~~ said substrate along a moving plane; and

providing a position detecting unit[[,]] which detects [[a]] positional information in a predetermined measurement direction of a mark on said substrate, ~~which is said substrate being~~ being mounted on the stage unit, wherein the position detecting unit comprises:

an imaging optical system which forms an image of the mark, formed on the substrate;

an image pick-up unit which picks-up [[a]] the image formed by said imaging optical system; and

a processing unit electrically connected to said image pick-up unit, which ~~obtains~~ estimates a relationship between ~~picked-up image state of the respective~~ a position of the picked-up image of said mark in said predetermined measurement direction and defocus

amount based image pick-up ~~results~~ result by using the said image pick-up unit under an image pick-up condition including a plurality of defocus states, and ~~detects~~ estimates positional information in said predetermined measurement direction of the marks said mark based on the estimated relationship.

19 (Currently Amended): A computer readable recording medium containing data for a control program to be executed by a position detecting unit to detect ~~a mark position~~ positional information in a predetermined measurement direction of said mark formed on a substrate, wherein

the said control program comprises:

allowing to pick-up at least one image of said mark under an image pick-up condition including a plurality of defocus states;

allowing to ~~obtain~~ estimate a relationship between ~~the picked-up image state a position~~ of said mark in said predetermined measurement direction and defocus amount, and to estimate positional information in said predetermined measurement direction of said mark based on the estimated relationship ; and

~~allowing to detect a positional information of said mark, based on the relationship.~~

20 (Original): A device manufacturing method including a lithographic process, wherein

an exposure is preformed by using said method according to claim 18 in said lithographic process.